

## REMARKS

Claims 1-47 are pending. Claims 1-6, 9-16, 18-34, 36, 38-41, 43, 44, 46, and 47 are rejected. Claims 7, 8, 17, 35, 37, 42, and 45 are indicated as being allowable, but are objected to as being based on a rejected claim.

Applicants appreciate the indication of allowable subject matter, but respectfully submit that the remaining claims also are allowable. Please reconsider the application in view of the following remarks.

**I. Rejection of claims 1-5, 9-16, 18, 26, 30, 31, 32, 34, 36, 38, 39, and 41**

The above-listed claims are rejected under 35 U.S.C. 102(b) as being anticipated by Wang et al. (U.S. Patent 5,977,616) (hereinafter "Wang").

Regarding claim 1, it is submitted that Wang does not anticipate the claim because Wang lacks the feature of "an encapsulant completely enclosing the die and the heat spreader." In all of Wang's figures, a top surface of heat spreader 32 is uncovered by his molding material 30. Further, Wang states "Preferably, the heat spreader is exposed by the molding compound." Accordingly, claim 1 is not anticipated.

Regarding claim 16, it is submitted that Wang does not anticipate the claim because Wang lacks the feature of "an encapsulant completely covering the heat slug." In all of Wang's figures, a top surface of heat spreader 32 is uncovered by his molding material 30. Further, Wang states "Preferably, the heat spreader is exposed by the molding compound." Accordingly, claim 16 is not anticipated.

The remaining claims are dependent on one of claims 1 or 16, and are not anticipated for at least the same reasons stated above.

## **II. Rejection of Claim 6**

Claim 6 was rejected under 35 U.S.C. 103 over Wang in view of Hawthorne et al. (U.S. Patent 6,008,991). Claim 6 is dependent on claim 1. The rejection of claim 6 is traversed on the same grounds as claim 1. Namely, Wang lacks the feature of “an encapsulant completely enclosing the die and the heat spreader.” Accordingly, a *prima facie* case of obviousness has not been made, and the claim should be allowed.

## **III. Rejection of claims 20-23, 43, 44, 46, and 47**

The above-listed claims were rejected under 35 U.S.C. 103 over Wang in view of Bernier et al. (U.S. Patent 6,069,023). The rejections are traversed.

Claim 20 includes the feature of “encapsulating the die and heat spreader completely.” Claim 23 includes the feature of “completely covering the heat slug with an encapsulant.” As discussed above with respect to claims 1 and 16, Wang does not completely cover his heat spreader 32 with his molding material 30. Wang leaves the top surface of heat spreader 32 uncovered. Accordingly, a *prima facie* case of obviousness has not been made, and claims 20 and 23 should be allowed.

The remaining claims are dependent on one of claims 20 or 23, and should be allowed for at least the same reasons as their respective independent claim.

## **IV. Rejection of claims 24, 25, 27, 28, and 29**

The above-listed claims were rejected under 35 U.S.C. 103 over Wang in view of Huang et al. (U.S. Patent 6,400,014). These claims are all dependent on claim 1. The rejections are traversed on the same grounds provided above for claim 1. Because Wang lacks a feature of the claim, a *prima facie* case of obviousness has not been made.

## **V. Rejection of claim 33**

Claim 33 was rejected under 35 U.S.C. 103 over Wang in view of Kajihara et al. (U.S. Patent 5,616,957). Claim 33 is dependent on claim 1. The rejection of claim 33 is traversed

on the same grounds provide above for claim 1. Namely, Wang lacks the feature of “an encapsulant completely enclosing the die and the heat spreader.” Accordingly, a *prima facie* case of obviousness has not been made, and the claim should be allowed.

**CONCLUSION**

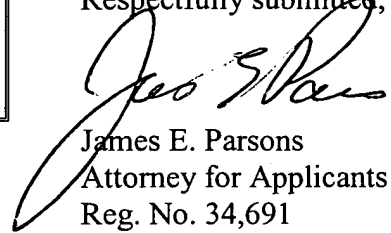
The rejections are respectfully traversed, and the claims should be allowed. Please direct comments or questions to the undersigned at (408) 451-5906

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Respectfully submitted,



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## APPENDIX PENDING CLAIMS

Below are the pending claims. None are amended in this paper

1. A semiconductor die package, comprising:
  - a substrate having a first and a second surface;
  - a die having a first surface and a second surface, wherein the first surface of the die is attached to the first surface of the substrate;
  - a heat spreader attached to the second surface of the die; and
  - an encapsulant completely enclosing the die and the heat spreader.
2. The die package of Claim 1, wherein the second surface of the die is the face containing active circuitry.
3. The die package of Claim 2, wherein the second surface of the die is electrically coupled to the first surface of the substrate.
4. (Previously Amended) The die package of Claim 3, wherein bond wires electrically couple the second surface of the die to the first surface of the substrate.
5. The die package of Claim 1, further comprising a conductive ball grid array coupled to the second surface of the substrate.
6. (Previously Amended) The die package of Claim 1, further comprising a thin layer of thermal conductive adhesive between the die and the heat spreader.

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7. The die package of Claim 6, wherein the thin layer is of the order of approximately 1 mil or less.

8. (Previously Amended) The die package of Claim 1, wherein the encapsulant covering an uppermost portion of the heat spreader is no more than 9 mils thick.

9. (Previously Amended) The die package of Claim 1, wherein the heat spreader comprises:

an interior planar portion overlying and attached to the die;

an outer planar portion overlying and attached to at least a portion of the substrate; and

a first angled portion extending from the outer planar portion towards the second surface of the die.

10. The die package of Claim 9, wherein the outer planar portion only overlies portions of the substrate in a direction extending laterally from the four sides of the die.

11. (Previously Amended) The die package of Claim 9, wherein the outer planar portion overlies substantially all of the substrate.

12. The die package of Claim 1, wherein the first surface of the die is the face containing active circuitry.

13. The die package of Claim 12, wherein the first surface of the die is electrically coupled to the first surface of the substrate.

14. (Previously Amended) The die package of Claim 13, wherein an array of solder bumps electrically couple the first surface of the die to the first surface of the substrate.

15. (Previously Amended) The die package of Claim 9, wherein a thin layer of encapsulant is located between the outer planar portion of the heat spreader and the first surface of the substrate.

16. (Previously Amended) A ball grid array (BGA) package, comprising:

- a substrate including a ball grid array;
- a die coupled to the substrate;
- a thin thermal conductive adhesive layer on the die;
- a heat slug attached to the die with the adhesive layer; and
- an encapsulant completely covering the heat slug.

17. (Previously Amended) The BGA package of Claim 16 wherein the encapsulant covering an uppermost portion of the heat slug is no more than 9 mils thick.

18. (Previously Amended) The BGA package of Claim 16, wherein the heat slug comprises:

- an interior planar portion overlying and attached to the die;
- an outer planar portion overlying and attached to at least a portion of the substrate; and

a first angled portion extending from the outer planar portion towards [the] an upper surface of the die.

19. The BGA package of Claim 18, wherein a thin layer of encapsulant is located between the outer planar portion of the heat slug and the upper surface of the substrate.

20. (Previously Amended) A method of dissipating heat from a ball grid array package, comprising:

- attaching a die to a substrate including a ball grid array;
- attaching a heat slug directly to the die; and
- encapsulating the die and the heat spreader completely.

21. (Previously Amended) The method of Claim 20, further comprising leaving a thin layer of encapsulant over an uppermost portion of the heat slug.

22. (Previously Amended) The method of Claim 20, further comprising forming a thin layer of encapsulant between an outer portion of heat slug and a surface of the substrate.

23. A method of packaging a semiconductor die, comprising:

- providing a substrate;
- attaching a first surface of the die to the substrate;
- attaching a heat slug directly to a second surface of the die, the second surface opposing the first surface; and
- completely covering the heat slug with an encapsulant.



24. (Previously Added) The die package of claim 1, wherein the heat spreader contacts the first surface of the substrate.

25. (Previously Added) The die package of claim 24, further comprising bond wires electrically coupling the second surface of the die to the substrate, wherein the heat spreader superimposes the bond wires.

26. (Previously Added) The die package of claim 2, further comprising bond wires electrically coupling the second surface of the die to the substrate, wherein the heat spreader superimposes the bond wires.

27. (Previously Added) The die package of claim 26, wherein the heat spreader contacts the substrate.

28. (Previously Added) The die package of claim 27, wherein the die has four peripheral sides, and the heat spreader contacts the substrate adjacent each of the four peripheral sides.

29. (Previously Added) The die package of claim 27, wherein the die has four peripheral sides, and the heat spreader contacts the substrate adjacent some but not all of the four peripheral sides.

30. (Previously Added) The die package of claim 1, wherein the second surface of the die includes bond pads electrically coupled to the substrate, and the heat spreader contacts the second surface of the die within a perimeter of said bond pads.

31. (Previously Added) The die package of claim 30, wherein the bond pads are each electrically coupled to the substrate by one of a plurality of bond wires, and the heat spreader superimposes the bond wires.

32. (Previously Added) The die package of claim 31, wherein the heat spreader contacts the substrate outward of a connection between the respective bond wires and the substrate.

33. (Previously Added) The die package of claim 31, wherein the heat spreader does not contact the substrate.

34. (Previously Added) The die package of claim 1, further comprising a metal ring coupled to the first surface of the substrate around the die and the heat spreader.

35. (Previously Added) The die package of claim 34, wherein the die is in a flip chip connection with the first surface of the substrate.

36. (Previously Added) The die package of claim 9, wherein the second surface of the die includes active circuitry, and bond pads electrically coupled to the substrate.

37. (Previously Added) The die package of claim 1, wherein a thickness of the encapsulant between an outer surface of the encapsulant and a closest portion of the heat slug is no more than 9 mils.

38. (Previously Added) The BGA package of claim 16, wherein the die includes an active surface with bond pads thereon, the heat slug is attached to the active surface within a perimeter of the bond pads.

39. (Previously Added) The BGA package of claim 38, wherein the bond pads are electrically coupled to the substrate using bond wires, and the heat slug arches over said bond wires.

40. (Previously Added) The BGA package of claim 39, wherein the heat slug is attached to the substrate.

41. (Previously Added) The BGA package of claim 16, wherein the heat slug includes a depressed region opposite a surface of the heat slug that is attached to an active surface of the die, said depressed region being filled with said encapsulant.

42. (Previously Added) The BGA package of claim 16, wherein a thickness of the encapsulant between an outer surface of the encapsulant and a closest portion of the heat slug is no more than 9 mils.

43. (Previously Added) The method of claim 20, wherein the heat slug is coupled to a surface of the die that includes a plurality of bond pads, said bond pads being electrically coupled to the substrate.

44. (Previously Added) The die package of claim 23, further comprising bond wires electrically coupling the second surface of the die to the substrate, wherein the head spreader superimposes the bond wires.

45. (Previously Added) The method of claim 23, wherein a thickness of the encapsulant between an outer surface of the encapsulant and a closest portion of the heat slug is no more than 9 mils.

46. (Previously Added) The method of claim 45, wherein a plurality of bond wires are electrically coupled to the second surface of the die, and the heat slug superimposes the bond wires.

47. (Previously Added) The method of claim 46, wherein a plurality of bond wires are electrically coupled to the second surface of the die, the heat slug superimposes the bond wires, and the heat slug is attached to the substrate.